REMARKS/ARGUMENTS

Claim Objections

Claims 1, 16, and 22-25 are objected to because of informalities.

Regarding claims 1 and 16, the Examiner objected to the use of the phrase "modulating a wavelength". Applicant amended the preamble of claim 1 to indicate that a light path transports an optical signal of a particular wavelength. The first limitation of claim 1 is amended to replace the phrase "modulating wavelength" with the more definitive phrase "modulating said optical signal". Similar amendments are introduced in counterpart system claim 16.

To clarify the terminology, Applicant notes that term "light path" is conventionally used to denote a channel within a medium (a fiber link or a concatenation of fiber links) through which an optical signal of a specific wavelength propagates from a source node to a sink node, possibly traversing several intermediate nodes. The specific wavelength defines the light path. Information is communicated from the source node to the sink node by modulating the optical signal by a respective information signal (e.g., the information signal may be data of a flow rate of 10 gigabits/second). A modulated optical signal, which occupies a wavelength band, is still (loosely) defined by the wavelength of the optical signal before modulation and a light path transporting the modulated optical signal is still (loosely) defined by the wavelength of the optical signal before modulation.

In order to identify a light path in an optical communications network, without demodulating the modulated optical signal to detect the information signal, it is known to use a low-frequency identifying signal to further amplitude-modulate the optical signal, which is already modulated by the information signal. The process of low-frequency amplitude modulation is devised so as not to interfere with the information signal. The low-frequency identifying signal is often referenced as a "signature". Details of the process are described in U.S. Applications 09/963,501(US Patent 6,968,131), 10/263,959 (US Patent 7,155,122), 10/452,511 (US Patent 7,142,783), 09/991,683 (US Patent 6,597,161), all assigned to the same assignee of the present

application and all are incorporated by reference as indicated in paragraph [0016] of the present application.

Regarding claims 22-25, the phrase "optical nodes that are provisioned with said optical signature" has been replaced by the phrase "optical nodes that are provisioned to process said optical signature" as suggested by the Examiner.

Claim Rejections • 35 U.S.C. § 103

Claims 1-3, 6-12, 14-18, 21-26, and 28-29 are rejected under 35 U.S.C. § 103 as being unpatentable over Heismann and Rajagopal et al. (U.S. Patent No. 7,120,118 B2).

Before discussing the individual claims, the Heismann and Rajagopal references are discussed and compared with the claimed system of the present application.

The Heismann Reference

Heismann describes an optical-signal tracking system for an all-optical network using identifying tones. In the introduction (page 47), Heismann states: "Operation of such all-optical networks will be substantially different from present communication networks and, hence, will require **new techniques** for managing and controlling the flow of a large number of optical carriers through the network. For example, it would be desirable to monitor continuously the proper **routing of the various optical carriers** through the network **without converting** the high-speed information data into electrical signals."

The advantage of such a system is stated in page 48 of the Heismann reference: "The frequencies of the tones and the low-speed digital information carried by them can easily be monitored at various points in the network using **optical taps** and **inexpensive low-speed detectors** ……Hence they permit continuous tracking of the proper **optical routing** through the network."

The Rajagopal Reference

Rajagopal discloses a method and a system for traffic engineering in a network. Rajagopal

employs a Traffic-Management Server (TMS) and introduces traffic management nodes (TMNs) to be coupled with a network. The TMNs monitor and classify network traffic. The Rajagopal abstract states: "The traffic management nodes monitor and classify traffic passing through the connecting network.", and in claim 1 Rajagopal describes a method comprising identifying a current path for **traffic traveling** from a source node to a destination node and identifying a **detour path** from the source node to the destination node traversing a detour node.

The Present Application

The light path-monitoring system disclosed in the present application applies to an optical communication network (OCN) comprising optical nodes interconnected by wavelength channels. A light path from a source optical node to a destination optical node may traverse a number of intermediate optical nodes and is identified by a unique optical signature in a manner similar, though not identical, to that used in Heismann. Numerous light paths may be established through the optical communication network and each light path may uniquely be identified by a corresponding optical signature.

The claimed system differs from Heismann in the first procedure, second procedure, and third procedure recited in claim 1 (and their counterparts in claim 16). The Examiner asserts that a combination of the teaching of Heismann and the teaching of Rajagopal would produce the method and system claimed in the present application.

Applicant respectfully disagrees.

Applicant notes that Heismann's system (like the claimed system of the present application) applies to an all-optical network where optical carriers are not demodulated to retrieve the baseband signal for processing in the electrical domain. As well known in the art, demodulation a process is quite costly and, in any case, such processing is protocol dependent. The Heismann system and the present invention <u>do not</u> examine the traffic carried by the optical signals. Both systems apply to light paths which may, or may not, carry traffic. For example, the system of the present application can be exercised during commissioning before the network is used to carry payload information signals and without the need to insert test traffic.

In a sharp contrast, the Rajagopal system relies on electrical-domain processing and uses IP-based utilities for traffic monitoring. A person skilled in the art would have no reason whatsoever to combine the Heismann system and the Rajagopal system simply because using the Rajagopal system requires optical-to-electrical conversion, and *vice versa*, **contrary to the teaching of Heismann**. If such conversion is done, then there is no point in using the low-frequency tone identifiers (signature) to monitor the light paths since – if one invests in the conversion to the electrical domain • all monitoring data are readily available and the optical-domain solution would be superfluous. The main reason for using the signature system within an all-optical network is to avoid the excessive cost of optical-electrical-optical conversion and the main objective of the claimed system of the present application is to realize optical-domain control while circumventing the limitations of optical-domain processing.

Rajagopal uses a Traffic-Management Server (TMS) and introduces traffic management nodes (TMNs) to be coupled with the network to be monitored. The present system uses optical taps and inexpensive low-speed decoders. The procedures listed in claim 1 of the present application were devised to circumvent the limitations of optical-domain processing.

Light paths in the Rajagopal Network

In a network comprising nodes of fine-granularity, such as routers or conventional circuit switches, each node connects to at least one neighboring node through a light path. A light path from a source optical node to a destination optical node may traverse an intermediate optical node. In the network considered by Rajagopal (FIG. 4), any two neighboring routers from among the illustrated routers E, F, G, H, I, J, K, L, M, N, and O, may be connected by a light path if network 420 uses optical transmission. A path from TMN 6 to TMN 8 through network 420 traverses routers M, N, and O. A path from router M to router N, for example, may be a light path traversing two or more optical nodes which are not illustrated in FIG. 4. Thus, the entire end-to-end path from TMN 6 to TMN 8 may comprise four independent optical paths separated by electronic nodes. Thus, the all-optical network of Heismann, or the optical communication network of the present invention, actually serves as an independent infrastructure • taken for

granted • of an IP-network. Thus, the present system and the system of Rajagopal function separately and cannot be combined in a single entity.

The Rajagopal system versus the claimed system

With respect to the Rajagopal reference, Applicant notes that there are at least two fundamental functional differences between the system of Rajagopal and the system of the present application.

The first difference is that Rajagopal teaches methods of forming alternate routes and **does not suggest or contemplate** identifying misdirected routes (paths). Rajagopal discloses a system for identifying alternate paths between a source node and a sink node while the present application discloses a system for detecting connectivity problems where a light path planned to traverse a specified sequence of nodes deviates from a planned trajectory. Rajagopal discloses a system for traffic management based on identifying available alternate routes from a source node to a sink node. Rajagopal states in the abstract: "The traffic management nodes **monitor and classify traffic** passing through the connecting network. Current paths through the connecting network are identified and used to build detour paths through the connecting network using traffic management nodes as detour nodes."

The second difference is that system of Rajagopal processes baseband signals while the claimed system processes low-frequency optical signatures that are easy to detect. A light path is uniquely defined by an optical signature which is detectable in the optical domain without resorting to costly optical-electrical-optical conversion. Applying the system of Rajagopal to the optical communication network of the present application would require demodulating an optical signal to detect the information signal.

Additionally, traffic management nodes (TMNs) coupled with a network nodes are required to monitor network traffic. In contrast, the claimed system does not require interconnecting the nodes of the Optical Communication Network to management nodes. As stated in paragraph [0038] of the present application, "An advantage of the method is that it does

not require any NMS (Network Management Systems) interaction and can be invoked at any node on a light path through a CLI."

Numerous other differences between the present system and the Rajagopal system may be identified; all stemming from their distinct functions and physical structures.

Regarding claim 1, the Examiner states that the method as described in the preamble and the first limitation is disclosed by Heismann.

Applicant acknowledges that the step of modulating an optical signal with an identifying optical signature is known in the prior art and has been described in detail in the incorporated references listed in paragraph [0016] of the present application. Although the first limitation of "modulating said optical signal with an optical signature detectable in the optical domain, the optical signature defining said light path" may be incorporated in the preamble of claim 1, it was included in the list of steps for clarity, given that the preamble mainly describes the optical communication network to which the claimed method applies.

With respect to the step of "executing a first procedure for identifying a first sequence of optical nodes currently receiving said optical signature", the Examiner refers to col. 4:29-43 in Rajagopal.

The first procedure identifies optical nodes which receive a signature identifying a light path devised to transport an optical signal of a specific wavelength from a specific source node to a specific destination node. The identified optical nodes may differ from the optical nodes along the planned path.

Rajagopal refers to a conventional route-tracing procedure. Col. 4:29-43 states: "…. For example, a route tracing program may be used by each TMN separately to discover the current network paths to the other TMNs (e.g., traceroute in IP, which increments the IP time to live (TTL) field in the IP header in successive datagrams and tracks returned ICMP messages to determine a current path from node A to node B). Alternatively, a route recording option may be used as part of an echo-back utility (e.g., the ping program in IP using the RR (record route) option)…."

Applicant notes that "Traceroute" used in Rajagopal is a program that records the route between two computers through the Internet, ICMP (Internet Control Message Protocol) messages report errors in the processing datagrams, and "ping" is a basic Internet program that allows a user to verify that a particular IP address is available. **Traceroute does not identify a misrouted light path**.

With respect to the step of "executing a second procedure for identifying a second sequence of optical nodes provisioned to form said light path between the source optical node and the destination optical node", the Examiner refers to block 212 of FIG. 2 in Rajagopal.

Applicant notes that the second procedure identifies the optical nodes planned to constitute a light path from a source node to a destination node. Block 212 of FIG. 2 in Rajagopal refers to a step of identifying one or more detour paths.

With respect to the step of "executing a third procedure based on a step of flooding of enquiry messages for identifying each optical node in said plurality of optical nodes that detects said optical signature", the Examiner refers to block 502, FIG. 5B, in Rajagopal.

The third procedure disseminates enquiry message to determine which optical nodes have received a signature of a specific light path. Due to potential misrouting, an optical node receiving the signature may not be eligible to receive the signature. Such information facilitates taking corrective action. Block 502 of FIG. 5 in Rajagopal relates to a procedure of identifying current paths through the network for traffic sent among the Traffic Management Nodes (TMNs). Thus, the two procedures are distinctly different.

With respect to the step of "executing a fourth procedure for identifying each optical node from among said at least two optical nodes that detects said optical signature", the Examiner refers to col.7:36-39 in Rajagopal.

Applicant notes that col. 7:36-39 in Rajagopal refers to a process of identifying a current path. This is not equivalent to identifying optical nodes that detect a specific signature.

With respect to the limitation of "the first procedure, second procedure, third procedure, and fourth procedure being initiated at a command-line interface of a selected start optical node determined to belong to said light path", the Examiner refers to the traffic management nodes (TMNs) in Rajagopal which provide monitoring step with all paths being monitored in block 200 of FIG. 2 in Rajagopal.

Applicant notes that, unlike the system of Rajagopal, the claimed system does not require processing the baseband data transported by a light path, which requires optical-to-electrical conversion and sophisticated receivers, and does not require additional management nodes such as the Traffic Management Nodes in the Rajagopal system. Please see paragraph [0028] of the present application "These procedures do not require any Network Management System (NMS) interaction. Trace (Light path Trace), Walk, Global Discovery and Local Discovery can be invoked from a Command Line Interface (CLI)."

Unlike baseband processing and incorporation of management nodes, the claimed system relies on optical taps and inexpensive decoders to detect optical signatures at intermediate nodes on the light path. Detection of the optical signature is accomplished without costly OEO (Optical-Electrical-Optical) conversion at intermediate nodes. The simplicity of the process of tracing and fault detection of light paths enables its incorporation **as part of a conventional CLI-based system**.

On page 4 of the office action, the Examiner further states that it is known to perform similar procedures to monitor a path in a communication network as shown by Rajagopal, e.g., in multi-path analysis in col 1:7-10.

Applicant notes that the referenced passage (col. 1:7-10) refers to systems and techniques relating to network traffic engineering such as multi-path analysis for managing machine communications in a network. The present application is not concerned with traffic engineering and need not be traffic-aware. Instead, it provides a method of identifying misdirected light paths, i.e., light paths which, due to installation error or equipment malfunction, stray away from their intended trajectories.

On page 4 of the office action, the Examiner states that one of ordinary skill in the art would have been motivated to do this since Heismann is focused on a particular technique of tracking an optical signal and Rajagopal provides procedures that incorporate signal/path tracking information into other management aspects of a communication network, e.g., identification of **current paths** in Fig. 2 and 5 to **determine alternate paths**.

Applicant respectfully notes that: (1) a combination of Heismann and Rajagopal, **if at all realizable**, would produce a system for determining alternate routes from one network node to another (please see FIG. 5 in Rajagopal), and (2) even if one is to equate a process of finding alternate routes to a process of identifying a light path that went astray, any combination of Heismann and Rajagopal would require fundamental changes in both.

Applicant notes Rajagopal provides traffic management by selecting a route from among a plurality of alternate routes for directing traffic from a first node to a second node in a network comprising a plurality of nodes. Naturally, this traffic-routing process requires identifying **current paths** from the first node to the second node. Rajagopal is silent regarding identifying a path intended to connect the first node to the second node traversing designated intermediate nodes which deviates from its planned trajectory and either misses the second node or uses different intermediate nodes. The present application provides a method and system for detecting and monitoring a light path between a source node and a destination node in an Optical Communication Network (OCN) for the purpose of detecting connectivity problems.

Considering the above functional and structural distinctions, and for at least the reason that Rajagopal does not provide or contemplate identifying misdirected paths, it is respectfully requested that the rejection of claim 1 be withdrawn.

Regarding claim 2, the Examiner states that Heismann in view of the APA and Rajagopal discloses: “The method of claim 1 wherein the step of executing said first procedure comprises the step of constructing a current list of optical nodes comprising said first sequence of optical nodes”. The Examiner refers to block 200 of Fig. 2 in Rajagopal.

Applicant notes that block 200 in Rajagopal relates to a process of discovering current network paths for all TMNs acting as both source and destination. Rajagopal operates at the IP level and does not consider an underlying optical domain.

Regarding claim 3, the Examiner states that the steps of “constructing a first list of optical nodes that are currently traversed in sequence by the light path from said selected start optical node to the source optical node; and constructing a second list of optical nodes that are currently traversed in sequence by the light path from said selected start optical node to the destination optical node”, would be obvious features to add.

Applicant notes that the steps of claim 3 enable the process of monitoring a light path between a source optical node and a destination optical node to be invoked at any optical node designated to be on the light path using a Command Line Interface. Such capability has significant operational implications and may not be considered obvious given that a process of monitoring a path would normally be invoked at the source node of the path.

Claim 6 is canceled.

Regarding claim 7, the Examiner states that Heismann in view of the APA and Rajagopal discloses a step of constructing a reference list of optical nodes comprising the second sequence of optical nodes. The Examiner refers to block 212 which identifies detour paths. The second sequence of optical nodes recited in claim 1 includes nodes provisioned to process a specific optical signature. The system of the present application detects misdirected paths and the existence, or otherwise, of detours is irrelevant.

Regarding claim 8, the Examiner states that Heismann in view of the APA and Rajagopal discloses the steps:

> constructing a third list of optical nodes that are provisioned to be on the light path from said selected start optical node to the source optical node; and
>
> constructing a fourth list of optical nodes that are provisioned to be present on the light path from said selected start optical node to the destination optical node.

The Examiner refers to col. 8:28-29 and col. 8 line 30.

Applicant notes that the paragraph in col.8:24-33 in Rajagopal describes a process of concatenation of two paths to form a path from a first Traffic Management Node (TMN 6) to a second Traffic Management Node (TMN 8) through an intermediate Traffic management node (TMN 3). The concatenated path traverses routers M, J, K, G of a public network 420 to reach TMN 3 and routers G, K, O of network 420 to reach TMN 8.

The Examiner equates TMN 3 to the start node, TMN 6 to the source node, and TMN 8 to the destination node recited in claim 8. The Examiner further asserts that “these nodes will process the optical signature of Heismann for tracking”.

Applicant respectfully submits that the nodes of network 420 are routers handling data packets not wavelength channels. Adjacent routers may be connected by light paths, with several independent light paths connecting TMN 6 to TMN 3, and several independent light paths connecting TMN 3 to TMN 8. None of the optical nodes along any light path is illustrated or discussed in the Rajagopal reference. In col. 7:3-9, Rajagopal states:

> "The TMNs 1, 2, 3, 4, 5, 6, 7, 8 are coupled with a public network 420, such as the Internet, which includes multiple routers E, F, G, H, I, J, K, L, M, N, O. The TMNs 1, 2, 3, 4, 5, 6, 7, 8 use the public network 420 to communicate with each other and may create a VPN for the end hosts 400 using either a separate protocol or the network protocol of the public network 420."

It may be argued however, that network 420 may employ wavelength-channel switches instead of fine-granularity routers. However, in such case, the Traffic Management Nodes of Rajagopal would have no useful role to play.

Applicant further notes that even if such equivalence can be established, then the start node, TMN 3, ought to be able to invoke a process of detecting an optical signature at the intermediate nodes M, J, K, K, O which belong to the public network 420. Thus, the routers E, F, …., N, O of the public network 420 have to be equipped with optical-signal detectors and the Traffic Management Nodes TMN 1 to TMN 8 would be replaced with simpler Command Line Interfaces having means of executing the method of the present invention.

Thus, given that the network considered in Rajagopal does not lend itself to the application of optical signatures to track a path from a source node to a destination node, it is respectfully requested that the rejection of claim 8 be withdrawn.

Regarding claim 9, the Examiner states that Heismann in view of the APA and Rajagopal discloses the step of identifying optical nodes that are provisioned to process said optical signature (along a light path from a selected start optical node to a source optical node). The Examiner states that if the nodes between TMN 3 and TMN 6 (col. 8:29-39) become part of a new path, they will process the optical signature of Heismann for tracking.

Applicant notes that the new path mentioned by the Examiner traverses a number of routers (packet switches) and DOES NOT CONSTITUTE a light path. Tracking a path using optical signatures applies to a network switching wavelength channels and is not applicable to the fine-granularity packet-switching network to which the Rajagopal invention is directed. For at least this reason, it is respectfully requested that the rejection of claim 9 be withdrawn.

Regarding claim 10, the Examiner states that Heismann in view of the APA and

Rajagopal discloses the step of identifying optical nodes that are provisioned to process said optical signature (along a light path from a selected start optical node to a destination optical node). The Examiner states that if the nodes between TMN 3 and TMN 8 (col. 8:29-39) become part of a new path, they will process the optical signature of Heismann for tracking.

As discussed above, regarding claim 9, the system of the present application applies to a wavelength-channel switching network (generally known as optical transport networks). The nodes of the packet-switching network in Rajagopal do not process optical signatures.

Regarding claims 11 and 12, the Examiner states that displaying such information is an obvious technique.

Claims 11 and 12 are canceled.

Regarding claim 14, the Examiner states that Heismann in view of the APA and Rajagopal discloses a step of constructing a specific list of optical nodes which detect the optical signature in response to a process of neighbour discovery. The Examiner refers to block 502 of FIG. 5, col. 7:36-39, block 200 of Fig. 2, and col.4:40-42 in Rajagopal.

Block 502 of Fig. 5, described in col. 7:36-39, identifies current paths through the network for traffic sent among the TMNs. FIG. 2 illustrates a process for deriving alternate routes through a network. Block 200 relates to discovery of current network paths for all TMNs acting as both source and destination. Col. 4:40-42 refers to the use of an echo-back program (such as the Ping program).

Applicant notes that processes of local discovery are commonly used in networks. Claim 14 merely extends a conventional discovery method to be based on detecting an optical signature. Claim 14 depends on claim 1, believed to be allowable.

Regarding claim 15, the Examiner states that Heismann in view of the APA and Rajagopal discloses the recited limitations.

Applicant notes that claim 15 adds a useful limitation to claim 1 believed to be allowable.

Claims 16, 17, 18, 21, 22, 23, 24, 25, 26, 28 are system claims corresponding to method claims 1, 2, 3, 6, 7, 8, 9, 10, 12, 14, and 15, respectively, as pointed out by the Examiner. Applicant's comments regarding the method claims are also applicable to the system claims. Claim 21 is cancelled

Claims 4-5, 13, 19-20, and 27 are rejected under 35 U.S.C. 103(a) as being unpatentable over Heismann in view of the APA, Rajagopal, and Sengupta.

Regarding claims 4-5, the Examiner states that the practice of pre-provisioning light paths and nodes on the light paths through a signature that uniquely identifies each light path is known in the art.

Applicant respectfully submits that claims 4 and 5 are not directed to pre-provisioning light paths and do not claim using unique signatures to pre-provision light paths. Rather, they claim a step of identifying all optical nodes which are already pre-provisioned to be on a light path and which have detected and processed a specific optical signature.

Applicant also submits that Sengupta uses well known MPLS-based signaling protocols to establish light paths through a network. These techniques require processing baseband signals and need not rely on optical signatures.

Regarding claim 13, the Examiner states that the claimed steps are known in the art.

Applicant submits that the steps of claim 13 relate to flooding optical signatures and, therefore, adds useful limitations to the base claim.

Claims 19, 20, and 27 are system claims that introduce limitations that correspond to the limitations introduced by the methods 4, 5, and 13, respectively, as pointed out by the Examiner. Applicant comments regarding claims 4, 5, and 13 are also applicable to claims 19, 20, and 27, respectively.

SUMMARY

Claims 1-5, 7-10, 13-20, and 22-29 are pending.

Claims 6, 11, 12, and 21 are canceled.

Claims 1, 16, 22-25 have been amended to address the deficiencies identified by the Examiner.

Claim 7 is amended to remove an unnecessary limitation. Claim 13 is amended to depend on claim 1.

No new subject matter has been added by way of the above amendments.

<u>An advisory action is requested at examiner's earliest convenience.</u>

In view of the foregoing, early favorable consideration of the application is earnestly solicited.

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